Generative AI for Cel-Animation: A Survey

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Contributions

- **A Structured Taxonomy**: We categorize and map Generative AI techniques to each stage of the traditional animation pipeline, from pre-production to post-production.

- **In-Depth Analysis**: We analyze the state-of-the-art methods for core tasks, including automated in-betweening, AI-assisted coloring, and generative storyboarding.

- **Future Outlook**: We identify the primary challenges and outline promising future research directions for creating more powerful, artist-centric AI tools.
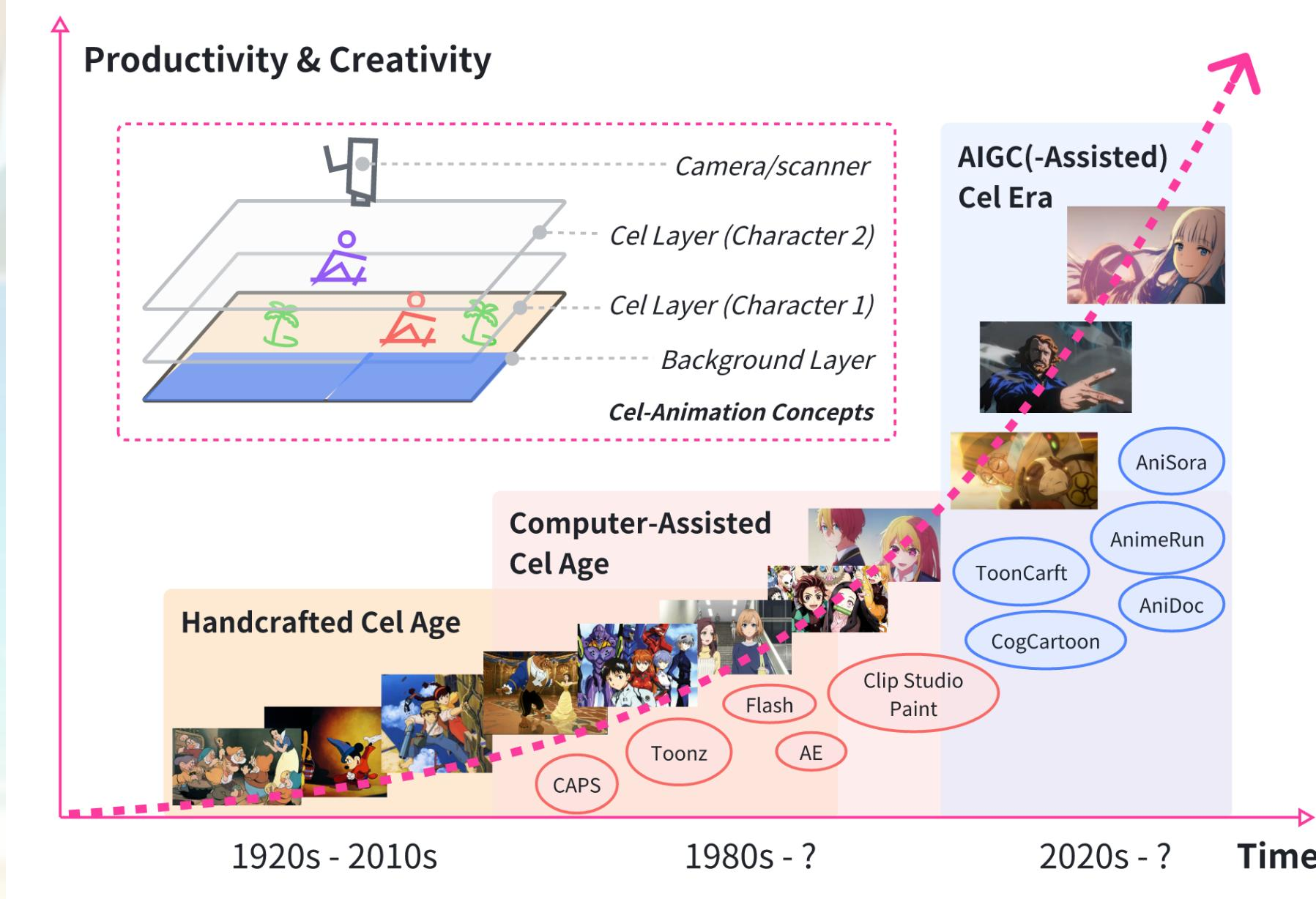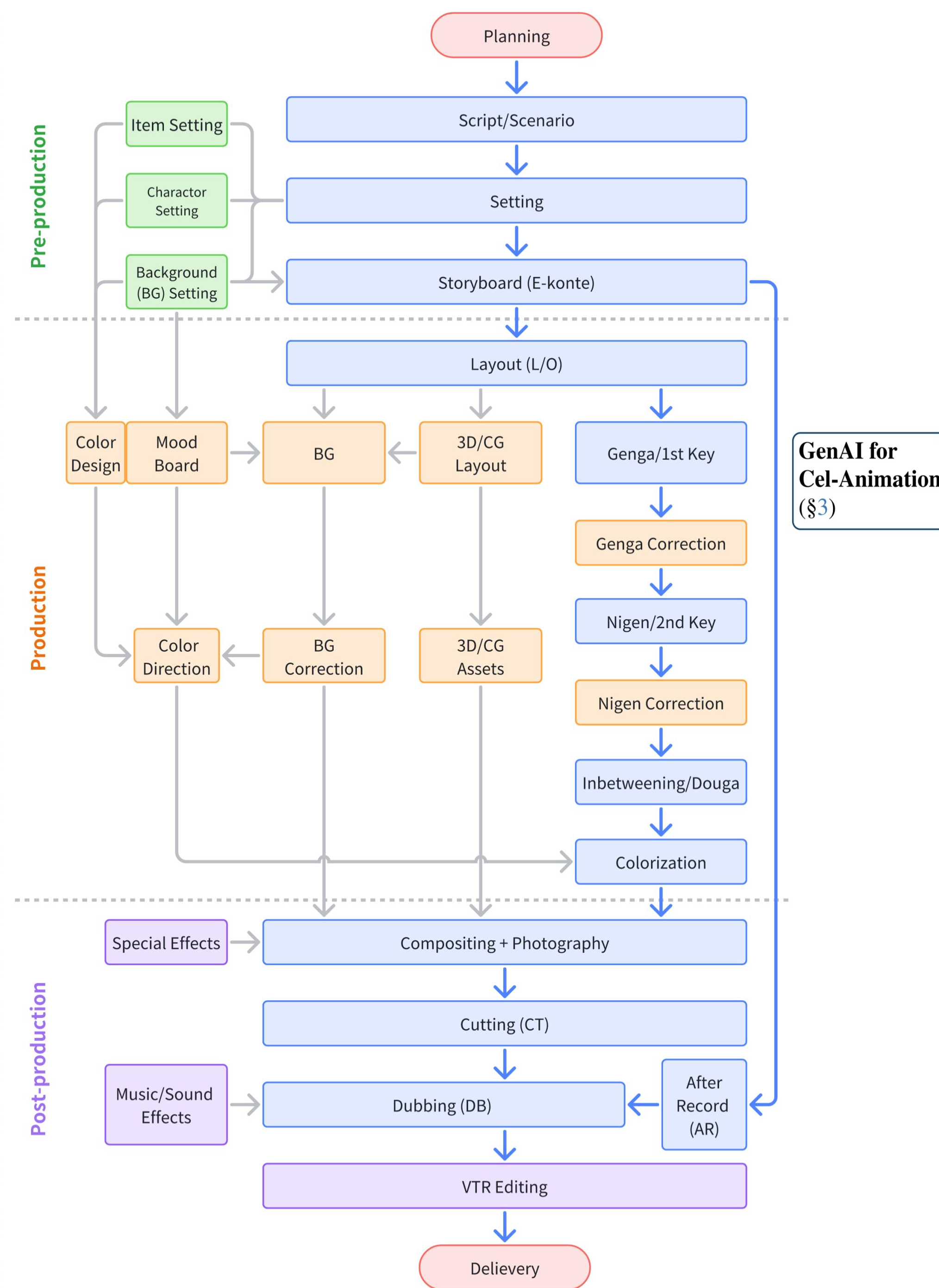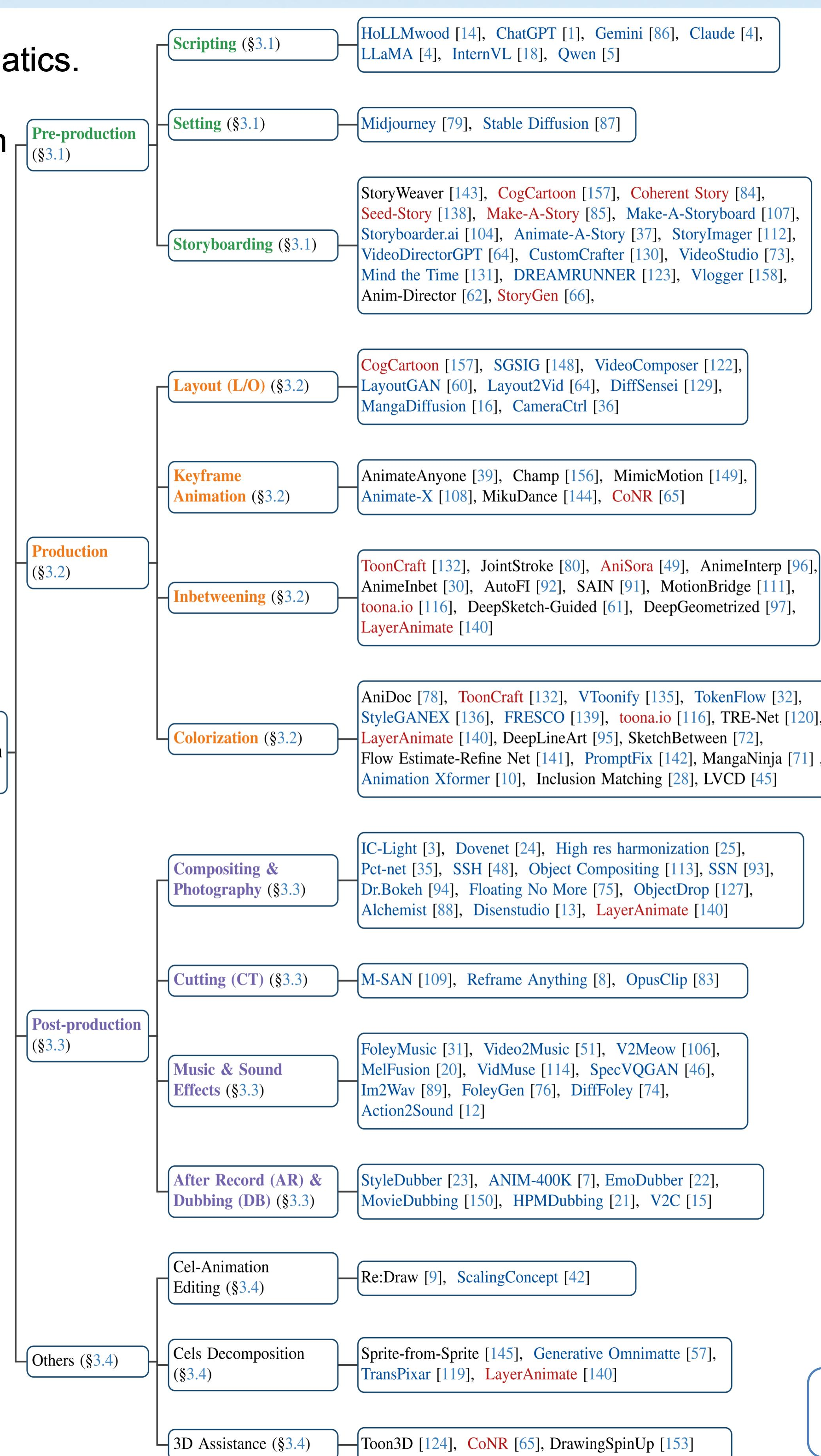

Evolution

- The **Handcrafted Cel Age** (1920s-2010s)

- The **Computer-Assisted Cel Age** (1980s-now)

- The Emerging **AIGC Cel Era** (2020s onward)

⬆ A layered structure of Celluloid is also shown.
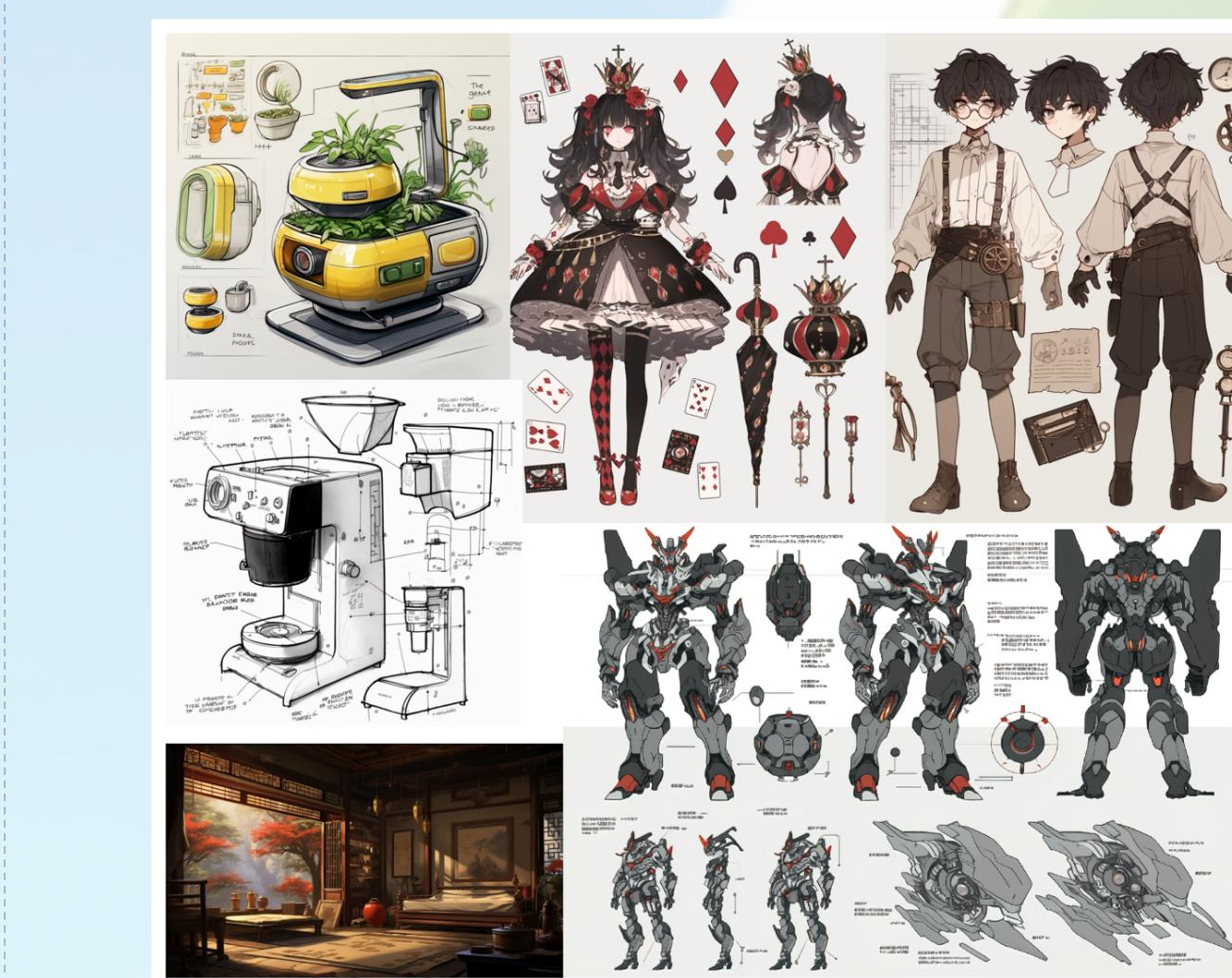
Traditional Pipeline

- **Pre-production**: Lays the creative foundation through storyboarding, character design, and animatics.

- **Production**: Creates the animated scenes through layout, keyframing, in-betweening, and coloring.

- **Post-production**: Finalizes by integrating visual effects, editing, sound design, and compositing.
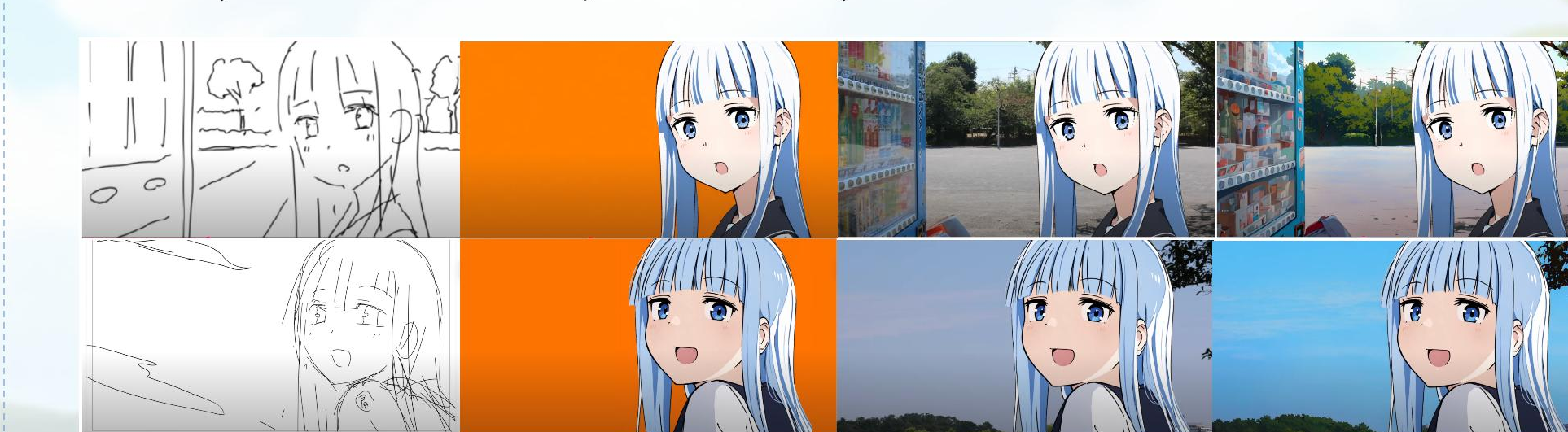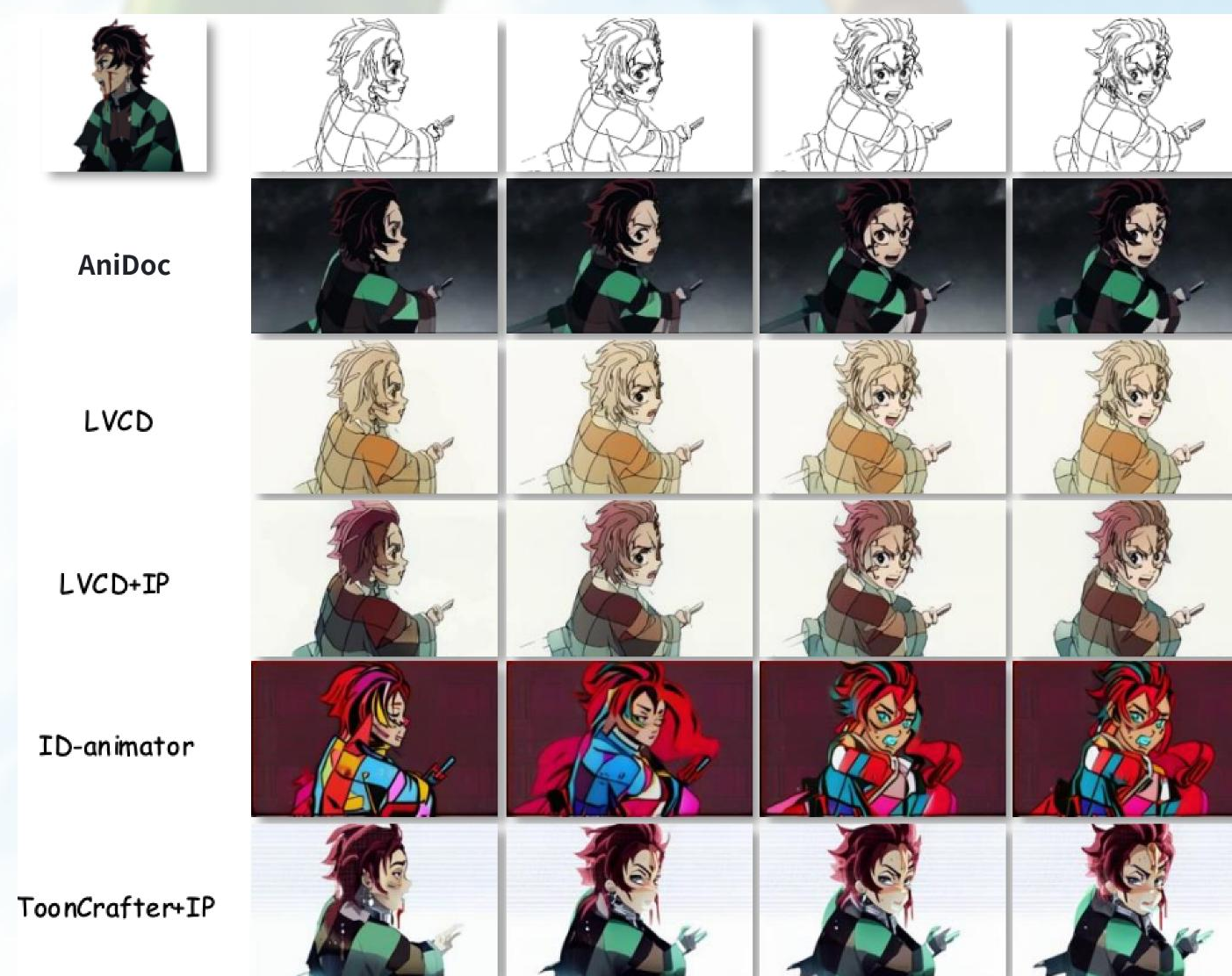

Taxonomy of GenAI for Cel-Animation

Pre-production (§3.1)

- Scripting (§3.1): HoLLMwood [14], ChatGPT [1], Gemini [86], Claude [4], LLaMA [4], InternVL [18], Qwen [5]

- Setting (§3.1): Midjourney [79], Stable Diffusion [87]

- Storyboarding (§3.1): StoryWeaver [143], CogCartoon [157], Coherent Story [84], Seed-Story [138], Make-A-Story [85], Make-A-Storyboard [107], Storyboarder.ai [104], Animate-A-Story [37], StoryImager [112], VideoDirectorGPT [64], CustomCrafter [130], VideoStudio [73], Mind the Time [131], DREAMRUNNER [123], Vlogger [158], Anim-Director [62], StoryGen [66]

Production (§3.2)

- Layout (L/O) (§3.2): CogCartoon [157], SGSIG [148], VideoComposer [122], LayoutGAN [60], Layout2Vid [64], DiffSensei [129], MangaDiffusion [16], CameraCtrl [36]

- Keyframe Animation (§3.2): AnimateAnyone [39], Champ [156], MimicMotion [149], Animate-X [108], MikuDance [144], CoNR [65]

- Inbetweening (§3.2): ToonCraft [132], JointStroke [80], AniSora [49], AnimeInterp [96], AnimeInbet [30], AutoFI [92], SAIN [91], MotionBridge [111], toona.io [116], DeepSketch-Guided [61], DeepGeometrized [97], LayerAnimate [140]

- Colorization (§3.2): AniDoc [78], ToonCraft [132], VToonify [135], TokenFlow [32], StyleGANEX [136], FRESCO [139], toona.io [116], TRE-Net [120], LayerAnimate [140], DeepLineArt [95], SketchBetween [72], Flow Estimate-Refine Net [141], PromptFix [142], MangaNinja [71], Animation Xformer [141], Inclusion Matching [28], LVCD [45]

Post-production (§3.3)

- Compositing & Photography (§3.3): IC-Light [3], Dovenet [24], High res harmonization [25], Pct-net [35], SSH [48], Object Compositing [113], SSN [93], Dr.Bokeh [94], Floating No More [75], ObjectDrop [127], Alchemist [88], Disenstudio [13], LayerAnimate [140]

- Cutting (CT) (§3.3): M-SAN [109], Reframe Anything [8], OpusClip [83]

- Music & Sound Effects (§3.3): FoleyMusic [31], Video2Music [51], V2Meow [106], MelFusion [20], VidMuse [114], SpecVQGAN [46], Im2Wav [89], FoleyGen [76], DiffFoley [74], Action2Sound [12]

- After Record (AR) & Dubbing (DB) (§3.3): StyleDubber [23], ANIM-400K [7], EmoDubber [22], MovieDubbing [150], HPMDubbing [21], V2C [15]

Others (§3.4)

- Cel-Animation Editing (§3.4): Re:Draw [9], ScalingConcept [42]

- Cels Decomposition (§3.4): Sprite-from-Sprite [145], Generative Omnimatte [57], TransPixar [119], LayerAnimate [140]

- 3D Assistance (§3.4): Toon3D [124], CoNR [65], DrawingSpinUp [153]

Visualization

Comparison of colorization generated by GenAI models. ⬇

⬆ Settings generated with GenAI, showing various designs including items, characters, scenes, and mecha.

⬅ Twins HinaHima: Generate cel materials from the storyboard.

Case Study

(1) *The Dog & The Boy* (2022), (2) *Rock, Paper, Scissors* (2023), (3) *Twins Hinahima* (2025)

Key Findings

- **Efficiency Boost**: AI excels at automating labor-intensive tasks like in-betweening, coloring, and storyboarding, drastically cutting production time.

- **Democratized Access**: AI tools lower technical barriers, making animation accessible to a wider range of creators.

- **The Control Challenge**: Maintaining artistic control and long-range stylistic consistency remains the primary technical hurdle.

- **Collaborative Future**: The trend is shifting towards interactive AI systems that act as a creative partner to the artist.

https://github.com/yunlong10/Awesome-AI4Animation (🌟 Stars: 180+)